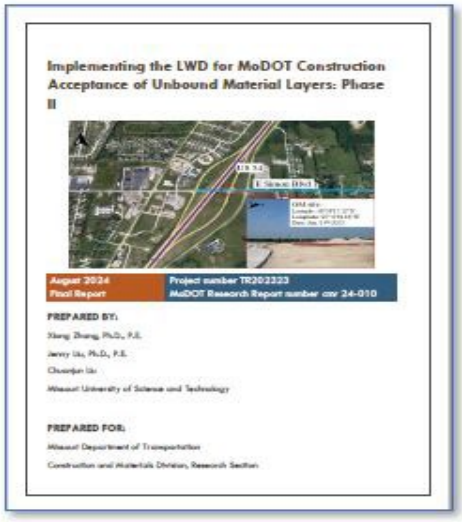
For more information contact: Brent Schulte (573) 526-4328

Research Summary

Implementing the LWD for MoDOT Construction Acceptance of Unbound Material Layers: Phase II



This Phase II project aimed to accumulate more field test data to improve the standards for the implementation of the Zorn lightweight deflectometer (LWD) for the acceptance of unbound materials layers. Five more different soils, including New Florence CL (lean clay), Holts Summit GM (silty gravel), Sikeston SM (silty sand), Rolla CL (lean clay), and Rolla GM (silty gravel), were collected from different project sites in Missouri for this project, and a series of laboratory and field tests were conducted.

Laboratory tests were conducted to determine basic properties of soils, including sieve analysis, Atterberg limits, and modified Proctor test. With maximum dry densities (MDDs) and optimum dry densities (OMCs) determined by modified Proctor tests, all collected soils were prepared at a relative compaction (RC) of 95% and various moisture contents for LWD tests on Proctor mold (with Lab 3.0 LWD) and repeated load triaxial tests (RLTTs).

A total of 582 field LWD tests were performed using three LWDs. (i.e., LWDs #3878, #3879, and #4421). These included 162, 126, 132, 81, and 81 tests at New Florence CL, Holts Summit GM, Sikeston SM, Rolla CL, and Rolla GM sites, respectively. Acceptance criteria including MC and field to target LWD modulus ratio were used to assess compaction acceptance of tested points at field sites.

In addition, a field moisture analyzer system was designed and validated for accurate and effective moisture measurement in the field. As shown in Figure 1, the system is composed of Ohaus MB 120 and a disturbance isolation unit which includes a 1000 W power invertor, four vibration isolation elements, a leveling platform, and a covering hood for Ohaus MB 120.

"…results indicated varying degrees of compliance across soil types and testing points in the field."

Based on substantial results from lab and field tests, conclusions were obtained as follows.

The three LWD devices were able to capture the moduli changes with variation of moisture contents on soils. Consistency between LWD devices was generally good, though discrepancies were noted at certain sites.

The designed disturbance isolation unit was effective in isolating vibrations and disturbance from the Ohaus MB 120 in the field. Sample weights of 10 g and 30 g were recommended for non-gravel and gravel soils in drying tests, respectively. A moderate switch-off criterion, e.g., 1mg/60s indicating no more than one

milligram change within 60 seconds, was recommended.

According to the moisture content and modulus ratio criteria, results indicated varying degrees of compliance across soil types and testing points in the field.

When compared with the NDG density-based evaluation method, LWD performed reasonably well for fine-grained soils such as clay and silt but poorly for coarse-grained soils. Among the three different LWD devices, results from LWD#3878 and #3879 were more consistent with the NDG density-based evaluation method than those from LWD#4421.

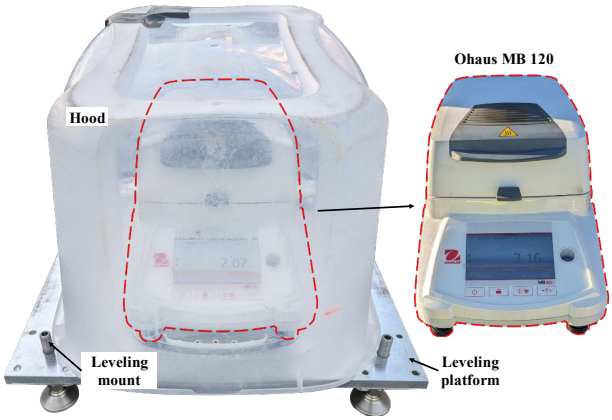


Figure 1: Field moisutre measurement system.

Project Information

PROJECT NAME: TR202103—Implementing the LWD for MoDOT Construction Acceptance of Unbound Material Layers: Phase II

PROJECT START/END DATE: February 2023-July 2024

PROJECT COST: $75,342

LEAD CONTRACTOR: Missouri University of Science & Technology

PRINCIPAL INVESTIGATOR: Xiong Zhang

REPORT NAME: Implementing the LWD for MoDOT Construction Acceptance of Unbound Material Layers: Phase II

REPORT NUMBER: cmr 24-010

REPORT DATE: August 2024

Project Manager

CONTACT INFORMATION:

Brent Schulte
Senior Research Analyst
Missouri Dept. of Transportation
1617 Missouri Blvd.
Jefferson City, MO 65109
(573) 526-4328
Brent.Schulte@modot.mo.gov